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New Record of Introduced Hosts for the Mountain Pine Beetle in California

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In a pine arboretum near Placerville, in northern California, 27 pine species, varieties, or hybrids—many of them introduced species—were attacked by the mountain pine beetle (*Dendroctonus ponderosae* Hopk.). Among these 27 species, 7 were reported previously as either native or introduced hosts; 5 introduced species or hybrids hitherto unreported as hosts, were killed; 5 introduced species or hybrids that were not killed were classified as probable hosts; and 10 species or hybrids were classified as only possible hosts. These results provide a basis for review and possible revision of the taxonomy of the mountain pine beetle.

Retrieval Terms: mountain pine beetle, *Pinus* spp., hosts

The mountain pine beetle (*Dendroctonus ponderosae* Hopk.) shows a surprising ability to attack and kill introduced conifers, particularly pines, growing in its range. Attacks on these species were recorded in Idaho: Scotch pine (*Pinus sylvestris* L.), eastern white pine (*P. strobus* L.), red pine (*P. resinosa* Ait.), jack pine (*P. banksiana* Lamb.), Austrian pine (*P. nigra* Arn.), pitch pine (*P. rigida* Mill.), and Norway spruce (*Picea abies* L.).[1] Ornamental plantings of Scotch pine killed by this insect were reported in Colorado.[2] In both States, the beetle did not attack native and common hosts growing in the immediate area: ponderosa pine (*P. ponderosa* Dougl. ex. Laws.) in Colorado, and that species and western white pine (*P. monticola* Dougl.) in Idaho.

On the west slopes of the Sierra Nevada of California below 7000 ft elevation, the mountain pine beetle is most often found on sugar pine (*P. lambertiana* Dougl.). Rarely is it found on ponderosa pine in that region. At higher elevations, the beetle is commonly found on lodgepole pine (*P. contorta var. murrayana* [Grev. & Balf.] Engelm.) and less often on western white pine.

Late in 1977, and continuing through 1978, when California was hit by a severe drought, we found the mountain pine beetle attacking 27 pine species, varieties, or hybrids at the Eddy Arboretum, Institute of Forest Genetics, near Placerville, California. Among the 27 species, 12 were classed as hosts, and 15 as potential hosts. At the Arboretum, many introduced pine species and pine hybrids grow intermixed with each other and with native hosts.[3] The beetles apparently came from a group of sugar pines growing nearby.

This study provides a basis for review and potential revision of the taxonomy of the mountain pine beetle. One approach to such work would be to use isozyme techniques. The results also have management implications. Care should be taken in selecting introduced pines to be grown within the range of the beetle. Accidental movement of this insect pest should be avoided—especially into areas where possible host species grow.

PROCEDURES

In this study, we first examined trees in the Arboretum to identify which were attacked and which were killed. All trees were 30 to 40 years old and ranged in size

from 8 to 14 inches diameter at breast height. And all were observed under drought conditions. We estimated the intensity of beetle attacks as indicated by pitch tubes. The tree ratings used were based on the average number of visible pitch tubes—globular masses of resin and insect frass formed on the bark surface at beetle entrance—per square foot of bark surface over the basal 20 feet of the tree: greater than 4 = heavy attack; from 1 to 4 = medium attack; less than 1 = light attack. The success of attacks on trees that were not killed was assessed by examining gallery construction of at least one attack at the 10- to 12-foot height on at least one tree of each attacked species, variety, or hybrid. We did so by carefully cutting through the bark to the cambium. More samples would have been desirable, but additional damage to the injured and valuable trees was to be avoided.

All attacked species were classed as hosts or potential hosts. Hosts are those reported killed in previous reports or killed in the Arboretum in 1977-78. Potential hosts are those attacked but not killed. Two subgroups of potential hosts were probable hosts and possible hosts. Probable hosts are those in which the beetle was able to turn the gallery upward and extend it at least an inch. Possible hosts are those in which gallery construction was <1 inch.

RESULTS AND DISCUSSION

Twenty-seven different species, varieties, or hybrids were attacked (*table 1*). These 27 were categorized as follows:

Hosts (12)	
Previously reported—native	4
Previously reported—introduced	3
Previously unreported—introduced	5
Potential hosts (15)	
Probable	5
Possible	10

Five introduced species or hybrids previously unreported as hosts were killed (*table 1*, no. 8-12). Five other species or hybrids (no. 13-17) were judged as probable hosts. Ten species or hybrids (no. 18-27) were classed only as possible hosts. The others (no. 1-7) were previously reported as hosts, but only *P. lambertiana* was killed of these 7.

The most noticeable and puzzling habit of this beetle was that it avoided its natural host, ponderosa pine, which was by far the most abundant species in the Arboretum and in surrounding plantations and natural stands. Not one *P. ponderosa* var. *ponderosa* was attacked, and only one tree each of its varieties *arizonica* (Engelm.) Shaw and *scopulorum* Engelm. was attacked—and both unsuccessfully. Few or no progeny were produced in the five species or hybrids of trees that were killed.

A comparison of beetle attacks in Idaho, Colorado, and California show differences as well as similarities:

- The beetle population sustained itself in the introduced species in Idaho and possibly but not likely in Colorado; it did not, however, sustain itself in California.
- *P. sylvestris* was killed in Colorado and Idaho, but not in California.
- Both *P. rigida* and *P. nigra* were killed in Idaho, but not in California.
- *P. resinosa, P. strobus,* and *P. banksiana* were killed in Idaho; none was attacked in California, although they were growing in the Arboretum where trees were being attacked. (No *P. contorta* was growing in the immediate area of the Arboretum.)
- The beetle failed to attack native host species in the immediate area in all three States.

The first four differences suggest variations in the genetic makeup, i.e., quality, of the mountain pine beetle in the three locations. Hopkins[4] placed *D. ponderosae* Hopk. in the central and southern Rocky Mountains, and *D. monticolae* Hopk. in the northern Rocky Mountains and throughout the Sierra Nevada and Cascades. Wood[5] placed *D. monticolae* under *D. ponderosae*. Our observations of the beetle's attack habits and success in the three geographic areas suggest that Hopkin's classification has some validity. The differences noted might also be explained by three other conditions: (a) population density, (b) physiologic and genetic characteristics expressed differently by the introduced species in different locations, and (c) stand age and density. Futher study appears to be warranted.

NOTES

[1]Furniss, M. M. ; Schenk, J. A. *Sustained natural infestation by the mountain pine beetle in seven new* Pinus *and* Picea *hosts*. J. Econ. Entomol. 62(2):518-519; 1969.

[2]McCambridge, W. F. *Scotch pine and mountain pine beetles*. Green Thumb 32(3):87; 1975.

[3]Liddicoet, A. R.; Righter, F. I. *Trees of the Eddy Arboretum*. Misc. Pap. 43. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1960. 41 p.

[4]Hopkins, A. D. *Contributions toward a monograph of the scolytid beetles. The genus* Dendroctonus. U.S. Dep. Agric., Bur. of Entomol. Tech. Ser. 17(1):1-164; 1909.

[5]Wood, S. L. *Revision of the genus* Dendroctonus *Erichson (Coleoptera: Scolytidae)*. Great Basin Nat. 21(1-2):1-117; 1963.

Table 1—*Actual and potential* Pinus *hosts of the mountain pine beetle and characteristics of attack, Institute of Forest Genetics (IFG), Placerville, California, 1977-78.*

Actual or potential hosts	Trees	Beetle attack	
		Intensity[1]	Success[2]
Hosts			
Previously reported—native			
1. *P. ponderosa* v. *arizonica*[3]	1	Light	>1 inch gallery
2. *P. flexilis* James[4]	2	Heavy	>1 inch gallery
3. *P. lambertiana*[4]	15	Heavy	>1 inch gallery*
4. *P. ponderosa* v. *scopulorum*[4]	1	Medium	only reach cambium
Previously reported—introduced			
5. *P. nigra*[3]	2	Medium	>1 inch gallery
6. *P. rigida*[3]	3	Medium	gallery turned, <1 inch
7. *P. sylvestris*[3,5]	5	Medium	>1 inch gallery
Previously unreported—introduced			
8. *P. echinata* Mill. × *taeda* L.	3	Medium	>1 inch gallery*
9. *P. roxburghii* Sarg.	11	Heavy	>1 inch gallery*
10. *P. muricata* D. Don	3	Heavy	>1 inch gallery*
11. *P. taeda* × *elliottii* Engelm var. *elliottii*	2	Heavy	>1 inch gallery*
12. *P. densiflora* Sieb. & Zucc.	4	Medium	>1 inch gallery*
Potential hosts			
Probable host			
13. *P. echinata* Mill.	1	Light	>1 inch gallery
14. *P. echinata* × *elliottii* var. *elliottii*	1	Heavy	>1 inch gallery
15. *P. griffithii* McCle.	1	Heavy	>1 inch gallery
16. *P. brutia* Ten.	2	Medium	>1 inch gallery
17. *P. rigida* × *taeda*	5	Light	>1 inch gallery
Possible host			
18. *P. attenuata* Lemm.	8	Medium	gallery turned, <1 inch
19. *P. elliottii* var. *elliottii*	4	Medium	gallery turned, <1 inch
20. *P. englemannii* Carr.	1	Light	only reach cambium
21. *P. leiophylla* Sch. & Dep.	1	Light	only reach cambium
22. *P. palustris* Mill.	1	Light	gallery turned, <1 inch
23. *P. palustris* × *elliottii* var. *elliottii*	1	Light	gallery turned, <1 inch
24. *P. patula* Sch. & Dep.	5	Medium	only reach cambium
25. *P. sondereggeri*[5]	3	Light	gallery turned, <1 inch
26. *P. taeda*	5	Medium	only reach cambium
27. *P. thunbergiana* Franco	2	Medium	only reach cambium

[1]Visible pitch tubes per square foot:
Light = <1
Medium = 1 to 4
Heavy = >4

[2]* = tree killed at IFG.

[3] See note (1) Furniss and Schenk.

[4]Beal, J. A. The Black Hills beetle, a serious enemy of Rocky Mountain pines. USDA Farmer's Bull. 1824. Washington, DC: U.S. Department of Agriculture: 1939; 21 p.

Evenden, J.C., and others. The mountain pine beetle, an important enemy of western pines. USDA Cir. 664. Washington, DC: U.S. Department of Agriculture: 1943; 25 p.

[5]See note (2) McCambridge.

[6]A natural hybrid of *P. palustris* and *P. taeda*.

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